

Remote Sensing of Mining



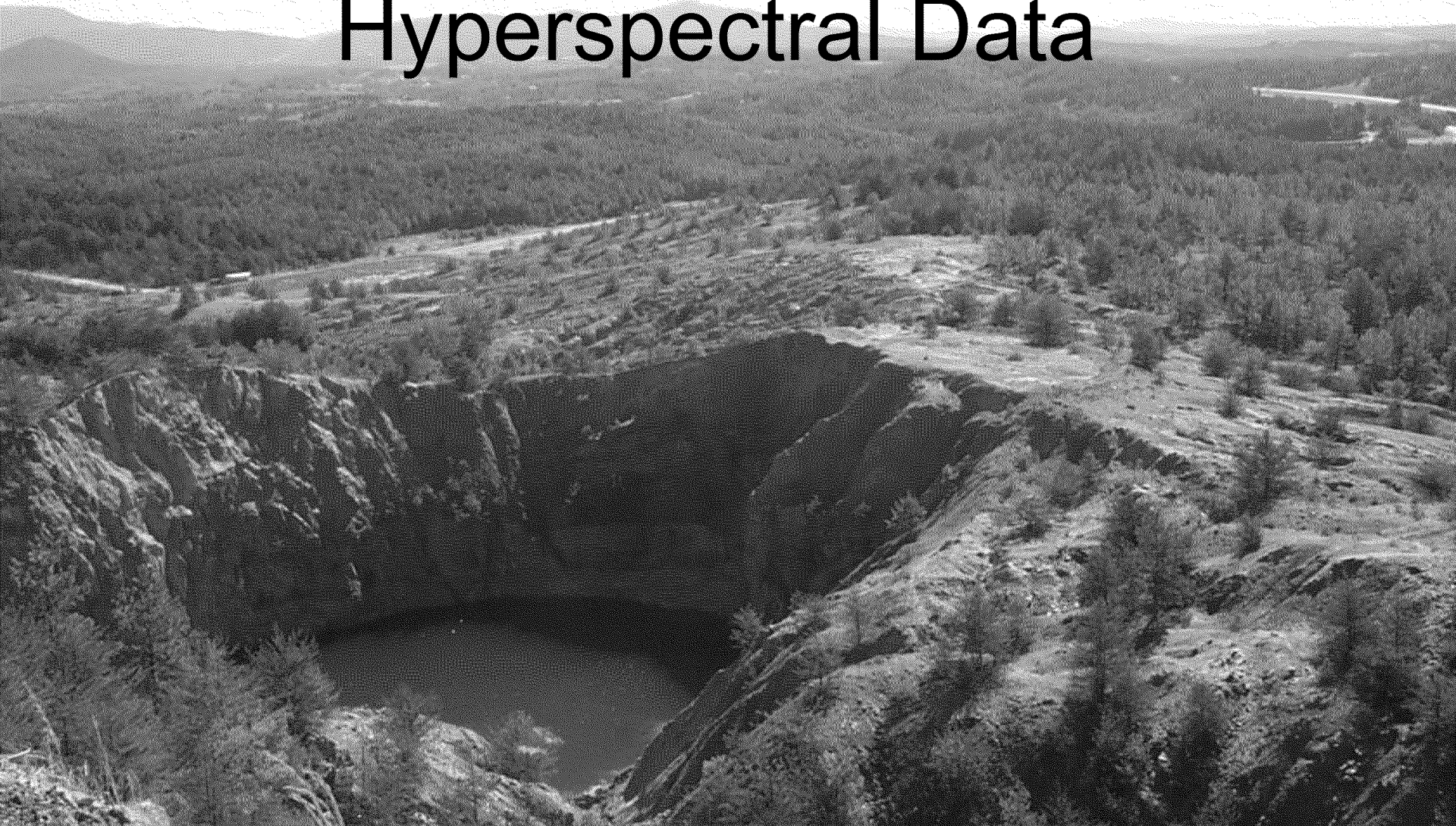
Courtesy of White Pine Public Museum

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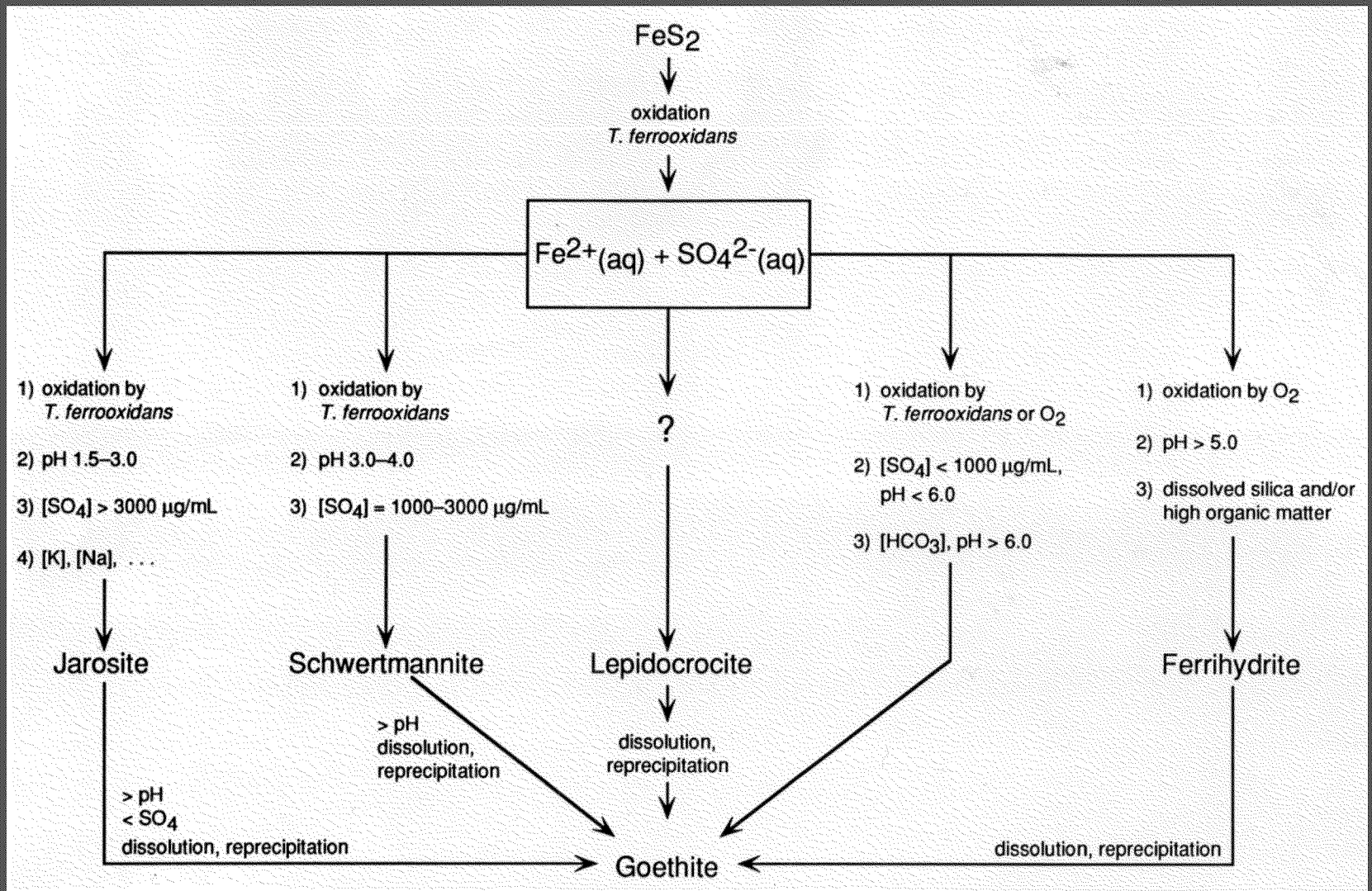
Remote Sensing Imagery

- Identification of mining operations
 - map the extent, changes over time
- Identification of tailings, overburden piles
- Determination of water quality degradation
 - mapping of acid mine drainage sediments
 - coal fines accumulation
 - watercourse diversions

Determining Water Quality in Mine-Impacted Areas using Hyperspectral Data

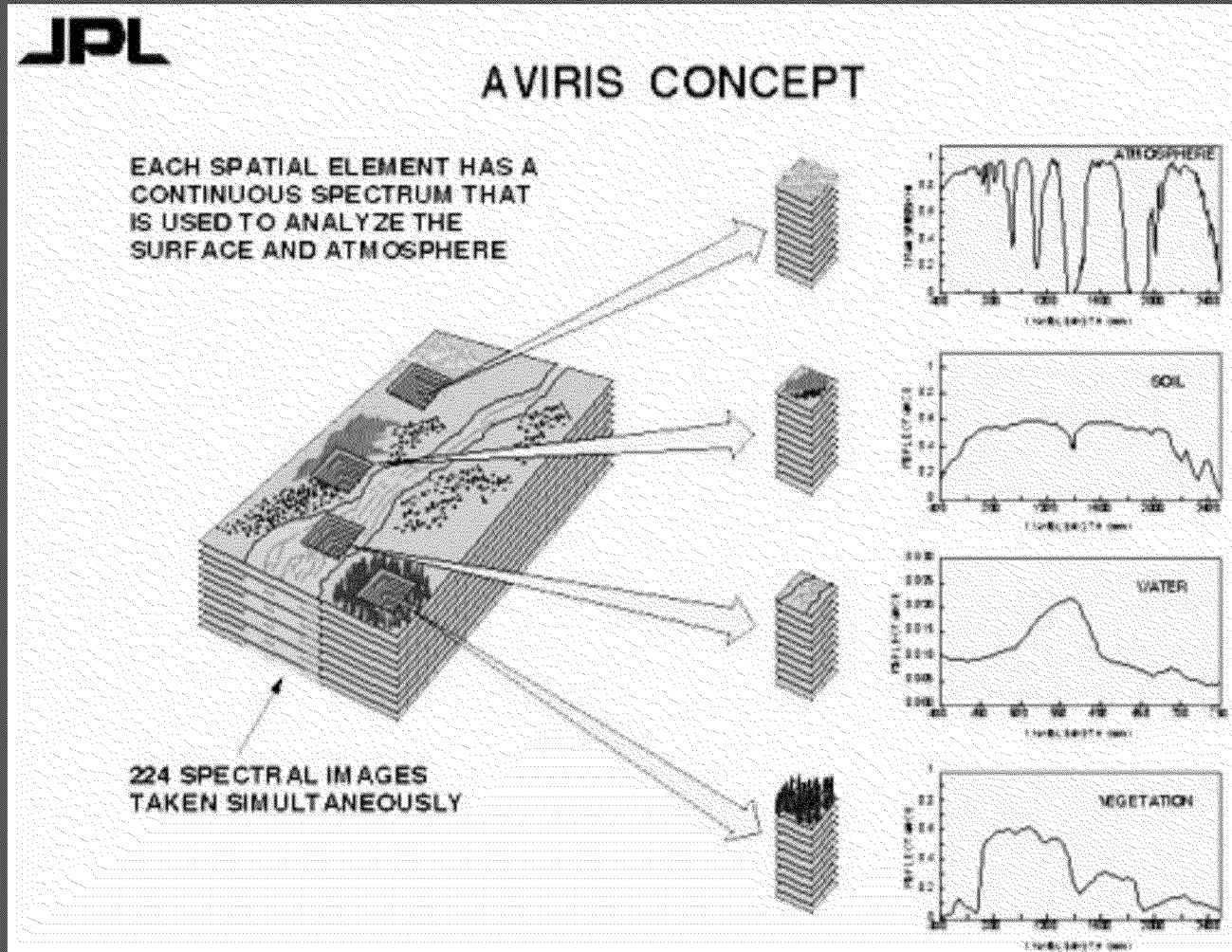


Biogeochemical model



Imaging Spectroscopy

- These spectra are used to derive information based on the signature of the interaction of matter and energy expressed in the spectrum.

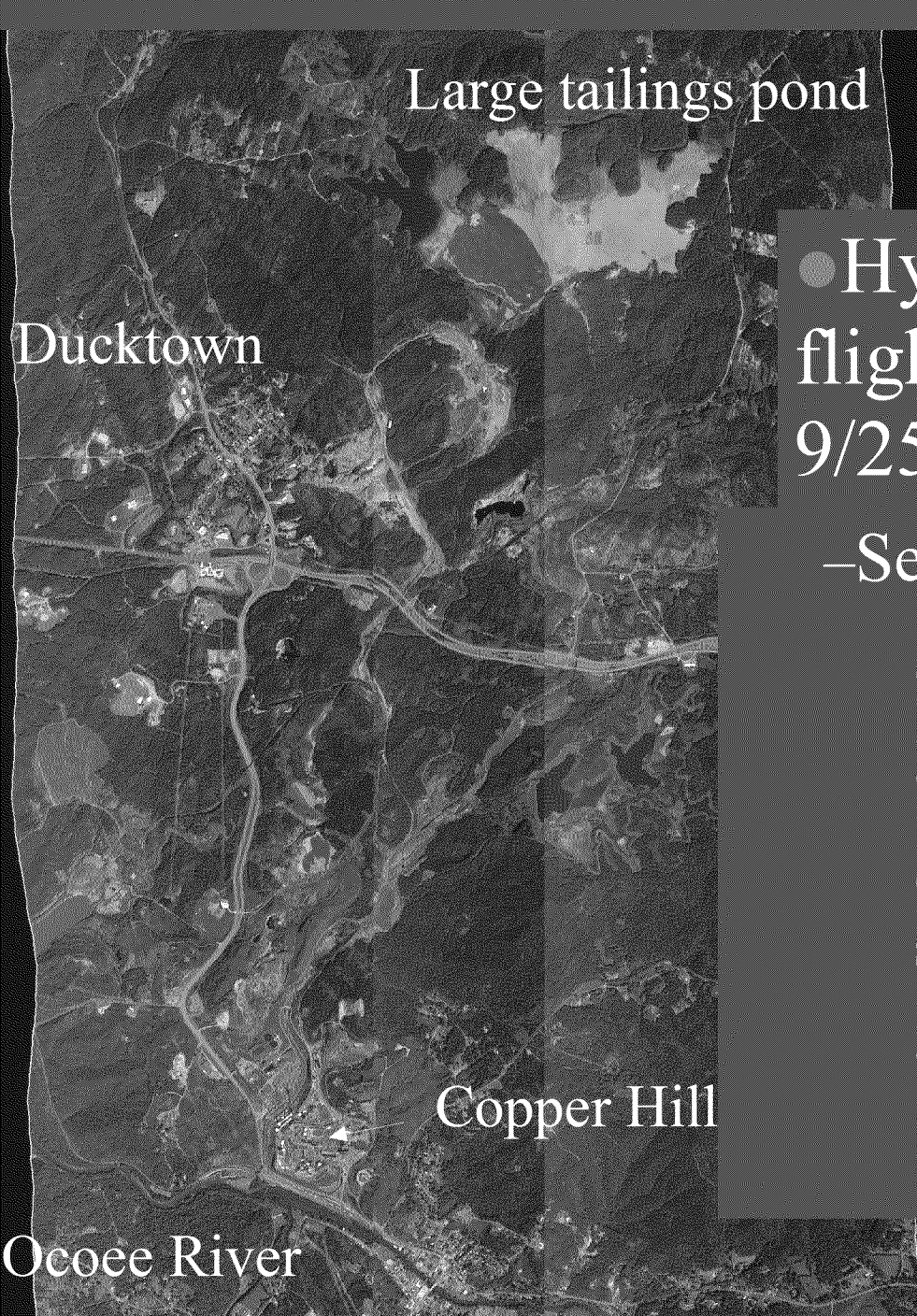


Imaging Spectroscopy at Copper Basin TN

- Mining of massive sulfide ores (iron and copper) began in 1850
- Two major mining companies
 - Cities Service Company
 - Tennessee Chemical Company (declared bankrupt in 1989)
- 1891 open heap roasting of copper ore began. 15 years later all vegetation was destroyed.



Mine drainage impacted stream at Copper
Basin, TN

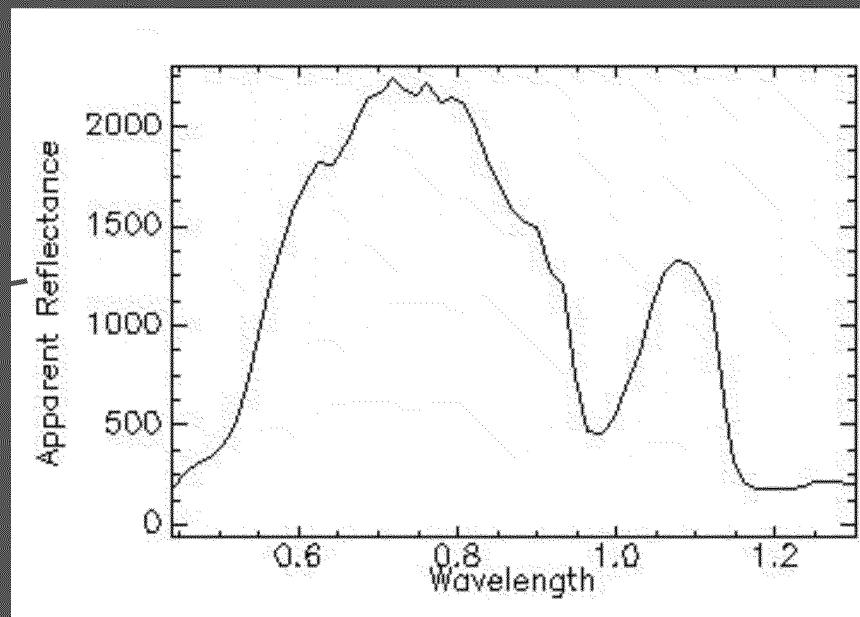


Methods

- HyMap sensor flew three flight lines over the area on 9/25/99
 - Sensor characteristics:
 - 126 spectral bands: 0.45 – 2.5 nm
 - 15nm bandwidths
 - Ground sampling distance (pixel size): 5 meter
 - Signal to noise ratio > 500:1



Copperhill

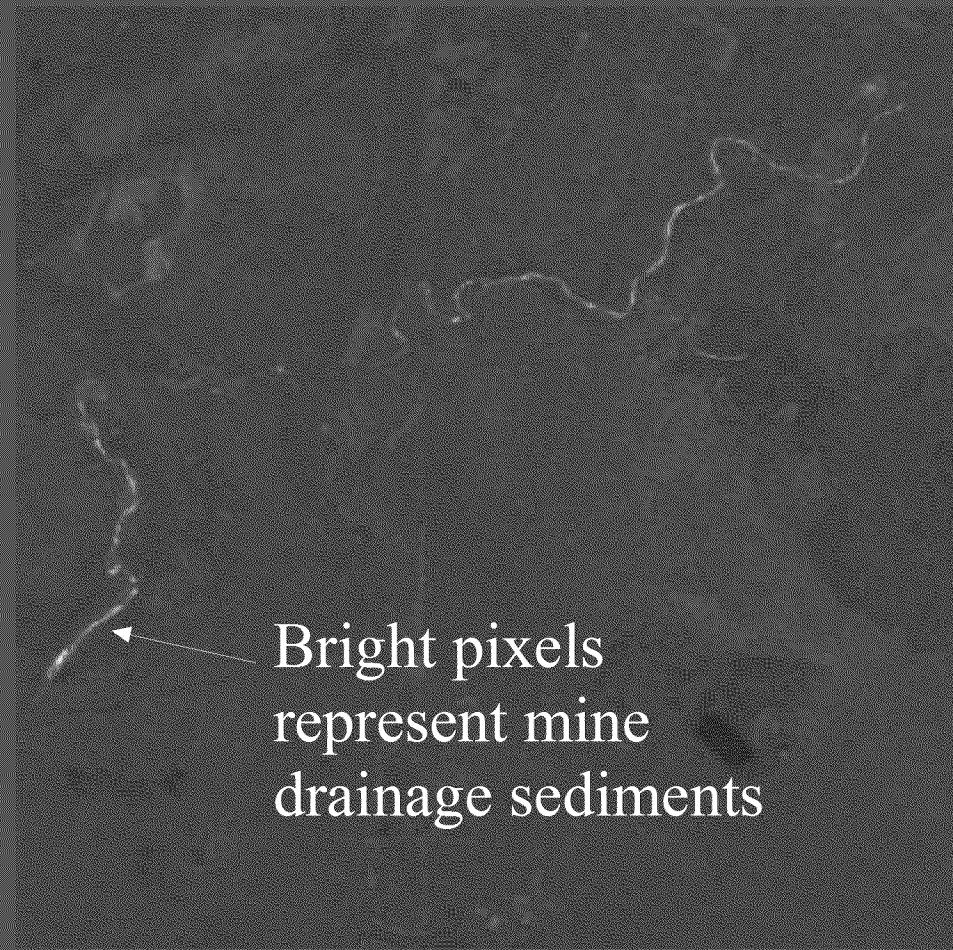


Results

- Mine drainage sediments in the North Potato Creek and Davis Mill Creek are comprised of schwertmannite with trace to small amounts of goethite
 - These minerals form in acid sulfate systems
- The pH of these stream reaches can be estimated to be pH 3-4 with moderate to high dissolved sulfate loads

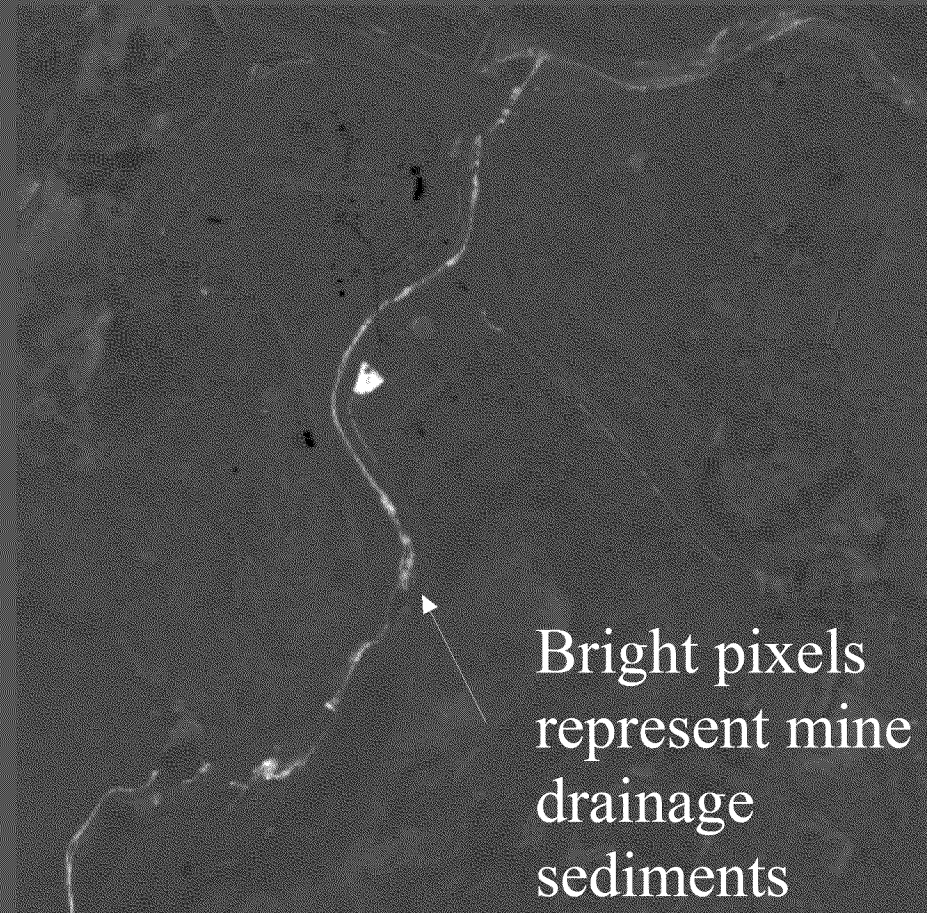
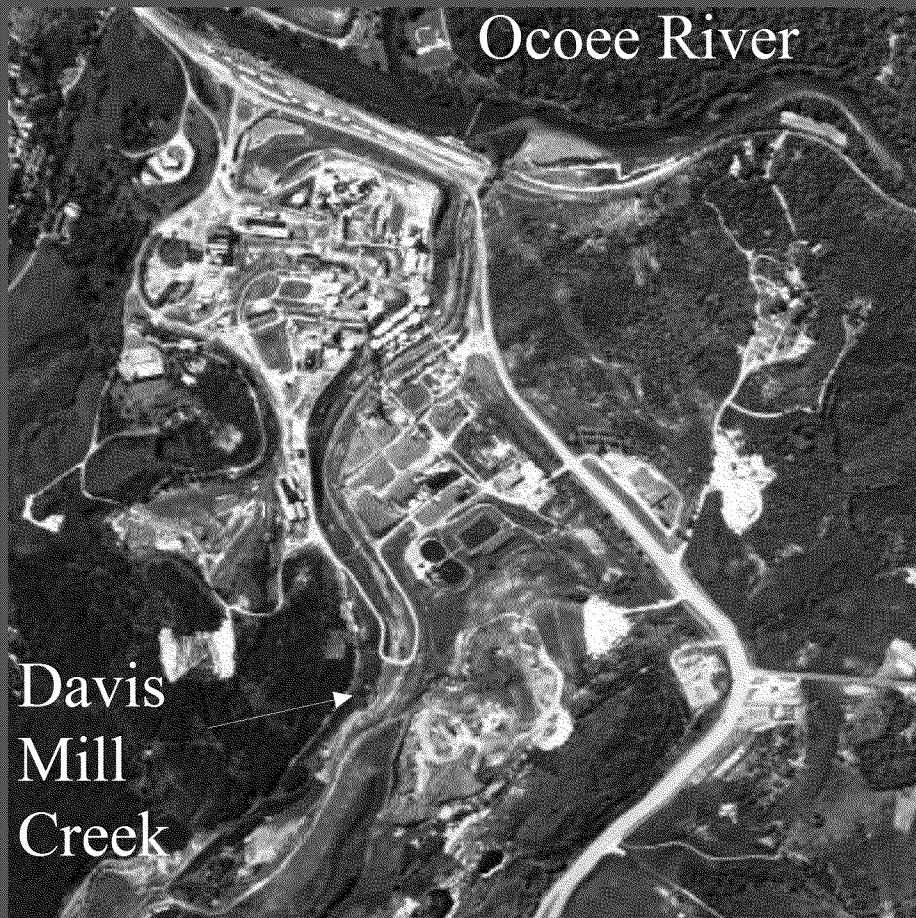
North Potato Creek

Image processing algorithm output



Bright pixels
represent mine
drainage sediments

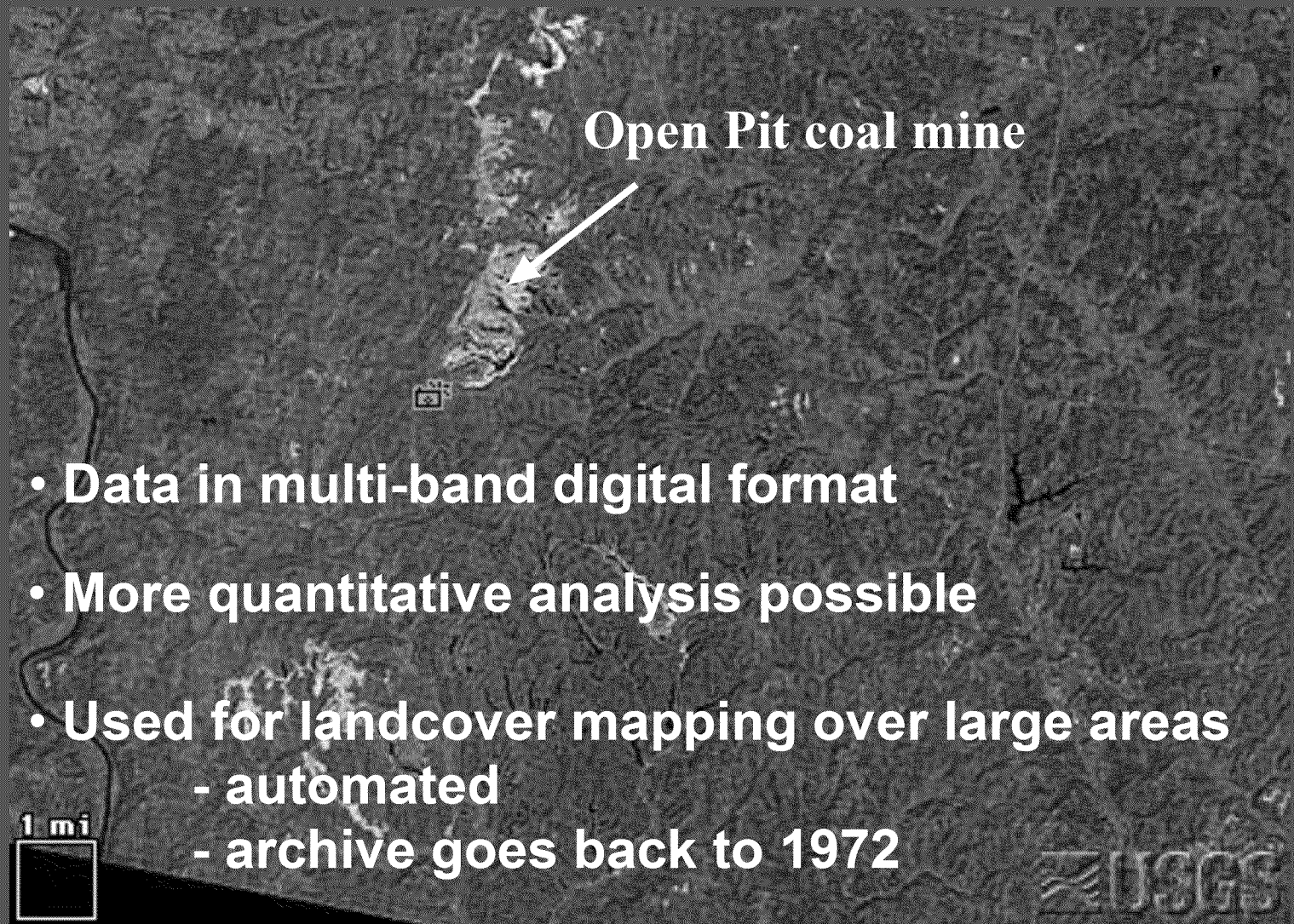
Copper Hill



Future Sensor Systems

- NASA Earth Observing 1 (EO-1) (launch April 13th, 2000)
 - Hyperion Sensor
 - 30 meter pixel resolution
- OrbView-4 by ORBIMAGE an affiliate of Orbital Sciences Corp. (launch late 2000)
 - 8 meter pixel resolution
- ARIES-1 Hyperspectral Resource Mapping Satellite (launch ~2001)
 - 30 meter pixel resolution

Satellite Multispectral Imagery



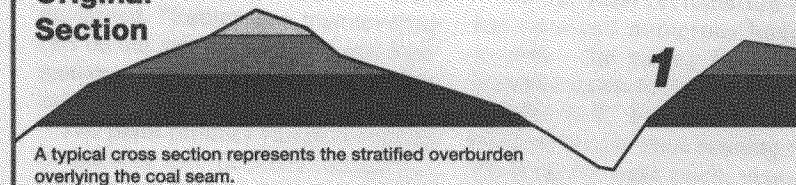
Mountain Top Removal



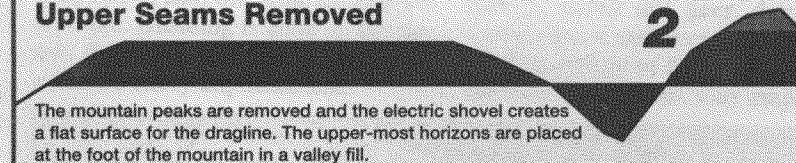
Method of Mining

Hobet's mountain top removal method employs five basic steps.

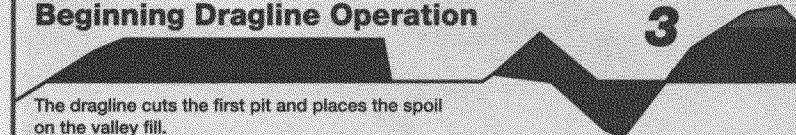
Original Section



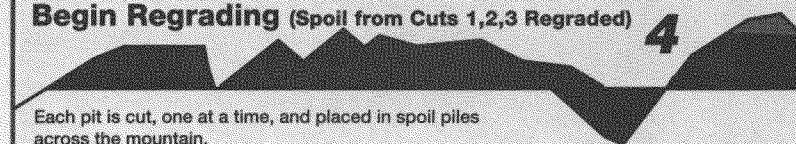
Upper Seams Removed



Beginning Dragline Operation



Begin Regrading (Spoil from Cuts 1,2,3 Regraded)



Regraded Section

